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AUTHOR Goldin-Meadow, Susan
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ABSTRACT

Longitudinal observations of six congenitally deaf children (1-4 years old) with hearing parents were performed to determine the structure of semantic relation representation. Ss' semantic relation phrases were analyzed in terms of case relations. Cases were found to be distinguishable from each other in terms of production probability. Two different types of agent cases were distinguished, one of which, the agent of an intransitive relation, was found to resemble the "patient" of a transitive relation in terms of production probability. Findings suggested that despite a lack of explicit conventional language model, the deaf child's communication system resembles aspects of certain natural languages. (Author/CL)

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STRUCTURED SEMANTIC RELATIONS IN A COMMUNICATION SYSTEM DEVELOPED WITHOUT A LANGUAGE MODEL: AN ERGATIVE SYSTEM

Susan Goldin-Meadow[1]

The University of Chicago

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The impact of the linguistic environment on a child's acquisition of language is most obviously seen in cross-cultural patterns: french children learn French, german German, italian Italian. Moreover, when exposed to conventional sign languages (e.g., American Sign Language or Signed English), deaf and hearing children learn these conventional sign languages. Thus, from a casual glance around the globe, we conclude that a linguistic model, if present, is important, at least on a gross level, in shaping the language acquired by a child. Our global glance, however, does not allow us to conclude that a language model must be present for language acquisition to occur. What if a child is exposed to neither French, nor German, nor Italian, nor American Sign Language? Would such a child develop a communication system, albeit a non-conventional one, despite that child's lack of linguistic input?

Over the past several years, we have studied just such a child, in fact, six such children, all lacking conventional language models but experiencing normal home environments in all other respects. Our subjects are deaf children whose hearing losses prevent them from making use of the natural oral language input that surrounds them. Moreover, these deaf children all have hearing parents who do not know any form of conventional sign language and therefore cannot themselves provide conventional manual input for their children. In addition, these parents have decided to provide a strictly oral education for their children (e.g., training to read lips and use other non-auditory cues to guide speech production). As a result, the children are exposed

to no conventional manual input either in the home or at school. Finally, at the time of these studies, our children had progressed minimally, if at all, towards acquiring facility with their "oralist" training. None was capable, for example, of either comprehending or producing two-word oral phrases. Thus, at present, our subjects are lacking all effective conventional language model input, either oral or manual.

We have found that, despite these limiting language learning conditions, our deaf subjects have developed a manual communication system which has many properties of natural spoken languages (Goldin-Meadow & Feldman, 1977). Moreover, this communication system is similar in many respects to the natural language system acquired by young hearing children during their early stages of development (Goldin-Meadow & Feldman, 1975). We focus on one aspect of the deaf child's communication system--case marking patterns--an aspect which also turns out to be a property of spoken natural languages.

Subjects, Procedure, and Coding Categories

Six congenitally deaf children, two girls and four boys, served as subjects in this study. Table 1 presents the ages of these children at the time of the interview. We contacted the children through two "oral" schools for the deaf in the Philadelphia metropolitan area. While the children differed in age, in the number of siblings (from zero to four), in race, and in socioeconomic background, they did, however, share two important characteristics. First, none was exposed to any conventional sign language or elaborate gesture system. Although

the parents of our subjects did occasionally gesture spontaneously, their gestures appeared to be neither as complex nor as structured as their children's gestures, e.g., the deaf children often produced two-sign phrases; however, their mothers produced very few such phrases and were, in general, much more likely to produce single sign phrases (see Goldin-Meadow & Feldman, 1975, for a more detailed description of the mother's role in the system).

Two investigators visited each child several times in his home. The sessions were relaxed and informal interactions. One experimenter engaged the child while the other videotaped the interaction from about ten feet away. The mother was often present in the room during the session. We usually invited her to join the interaction but left the decision to participate up to her. At each interview we brought a set of attractive children's toys both to elicit communication and to restrict the topic of conversation. They included mechanical action toys, static toy objects, pictures of both the action and object toys, picture books, and puzzles (see Feldman, 1975 and Goldin-Meadow, 1975, for a complete description of stimuli and procedures).

The videotaped sessions were used to develop a coding system to get at the forms and meanings of the subjects' gestured signs (see Feldman, Goldin-Meadow & Gleitman, 1977, for a description of the rationale behind our coding decisions and for the details of the categories and reliability measures). First, instances of communicative gestures were designated in the stream of motor behavior. Communicative gestures were behaviors which were directed to a person but which did not affect that person as a

direct motor act (see Smith, 1969, for an elaboration of this criterion in animal communication). For example, if a child physically restrains his partner, this act is not considered a sign. However, if the child holds up his open palm in a stop-like gesture and indirectly restrains his partner through the meaning of his act, that act is a sign. The physical form of the signs were described using a system similar to the one used to describe American Sign Language (Stokoe, 1960). In a randomly selected sample of videotape, 84% of the gestures identified by either of two coders were identified and similarly described by both coders. Second, on the basis of physical criteria, these gestures were broken down into single sign units analogous to words and into multi-sign units analogous to phrases. Of the gestures identified by both coders, there was 93% agreement on word boundary assignment and 95% agreement on phrase boundary assignment. Finally, by the method of "rich interpretation" (Bloom, 1970), referents (e.g., you, eat) were assigned to all word signs, and semantic cases or predicates (e.g., actor, act) were assigned to the individual signs in all multi-sign phrases. Of the gestures identified by both coders, there was 93% agreement on reference assignment and 97% agreement on semantic element assignment.

A Brief Introduction to the Communication System

Our previous work has shown that deaf children under relatively impoverished language learning conditions can indeed invent a communication system which has many of the properties of natural languages. In particular, the children develop a lexicon

composed of deictic signs, signs of unchanging form which indicate referents in the here-and-now (e.g., pointing gestures and occasionally, hold-up gestures), and characterizing signs, signs which characterize a referent by capturing a feature of that referent in the form of the sign (e.g., twist in the air = OPEN; hand in O-shape bobs back and forth at mouth = EAT; flat palm glides forward in air = GO; palms protruding from sides of head = MICKEY MOUSE) (see Feldman, 1975, for a complete description of the deaf child's lexicon).

In addition, we have found that the children concatenate these lexical items into phrases which convey semantic relations. Moreover, these phrases can be characterized in terms of two distinct syntactic rules: sign order rules and production probability rules (see Goldin-Meadow, 1977, for a detailed account of these syntactic devices). Sign order rules describe the likely position of a case or predicate in a two-sign phrase. For example, a child communicating about eating grapes will tend to first point at the grape, and then sign EAT; that is, he will first produce the sign for the patient case and then the sign for the act predicate. Similarly, if the child is communicating about transferring a book to the table, he will point first at the book, the patient, and then at the table, the recipient. In general, patients tend to occur before acts which tend to occur before recipients in the deaf children's two-sign phrases.

Production probability rules describe the likelihood that a particular case or predicate will be signed in a phrase when that case or predicate can be signed (an assignation determined on

contextual grounds) in that phrase. For example, consider a child who is apparently limited to producing two-sign phrases but who, from the non-linguistic context, appears to be communicating about an actor, e.g., you, eating grapes. In this situation, our deaf subjects will tend to explicitly sign the patient case (grape) and the act predicate (EAT), and will omit the sign for the actor case (you). In general, the patient is the most likely case to be signed (i.e., has the highest production probability) while the actor is the least likely to be signed (and has the lowest production probability).

In sum, the deaf children's system appears to have lexical and syntactic devices to make reference and to convey semantic relations, and is therefore a natural language in just these respects. In addition to these properties, the deaf children's system appears to exhibit a further natural language property--case marking patterns. In the following sections, I shall show that each of the two syntactic devices in the deaf children's system characterizes a case marking pattern. Moreover, both of these devices characterize the same case marking pattern which happens to occur in natural spoken languages, commonly called Ergative languages.

Case Marking Patterns: An Ergative System

To describe the Ergative pattern as it is found in natural languages, I shall begin by contrasting Ergative languages with English, a language which has an Accusative case marking pattern. The hallmark of the distinction between Ergative and Accusative languages is the manner in which the intransitive actor (or agent)

is marked (Fillmore, 1968). Consider the intransitive phrase "you go to the table;" in this phrase, the intransitive actor "you," in some sense, has a double-meaning. On the one hand, "you" refers to the "goer," the "actor," the "effector" of the going action. On the other hand, the "you" refers to the "gone," the "patient," the "affectee" of the going action. At the end of the action, "you" both "have gone" and "are gone," in some sense, and the decision to emphasize one aspect of the actor's condition over the other is to a certain extent arbitrary.

In English, we choose to emphasize the effector properties of the intransitive actor "you" by marking it like other effectors. For example, the intransitive actor "you" in "you go to the table" is marked just like the transitive actor "you" in "you eat grapes;" that is, both actors precede the verb. In contrast, Ergative languages emphasize the affectee properties of the intransitive actor by marking it like other affectees (i.e., patients). Thus, the intransitive actor of a going relation (you) is marked just like the transitive patient of an eating relation (grapes). In sum, Accusative languages highlight the effector properties of the intransitive actor by "grouping" it with transitive actors, while Ergative languages highlight the affectee properties of the intransitive actor by "grouping" it with transitive patients.

The relevant question now becomes: Which pattern, if either, does the deaf child's communication system exhibit? How does the deaf child mark the intransitive actor? Below I suggest that the deaf child uses both of his syntactic devices, production

probability and sign order, to mark intransitive actors like patients; his communication system is therefore Ergative in these respects.

Production probability. Production probability as a marking device is a property of the deaf child's system primarily because the child appears to have more to convey than he has room for in his sign phrases. At some stage our deaf children are limited to two-sign phrases, much as hearing children go through a two-word phase (cf., Brown, 1973). Note that if the child is to communicate about "you-eating-grapes" or "you-going-there" in a two-sign phrase, some aspect of his three-part message will have to be omitted from the surface form of his phrase.[2] Figure 1 is a representation of which cases are likely to be omitted and which are likely to be signed in the deaf children's two-element phrases. The figure presents production probabilities as a function of semantic case for the patient, intransitive actor, and transitive actor cases in all six children. It is readily apparent that the patient case, as mentioned above, is very likely to be explicitly signed in two-element phrases. This stands in contrast to the transitive actor which is most likely to be omitted. However, in terms of Ergativity, the crucial case marking is that of the intransitive actor. As Figure 1 shows, the six deaf children marked intransitive actors like patients, and not like transitive actors with respect to production probability. That is, the children were likely to sign the intransitive actor case just as they were likely to sign the patient case in their two-element phrases. In contrast, all of the six children were likely

to omit the transitive actor case. Thus, the "you" in "you go there" was just as likely to be signed as the "grape" in "you eat grapes;" and both were much more likely to be signed than the "you" in "you eat grapes." With respect to production probability, then, the deaf children's system appears to emphasize the affectee (and not the effector) properties of the intransitive actor; that is, the system appears to be Ergative.

Sign order. Recall that the patient case tends to occur in first position in the deaf child's two-sign phrases. If the child's system were Ergative when considered in terms of sign order, we would expect intransitive actors, like patients, to occur in first position. Moreover, we would expect intransitive actors to differ from transitive actors with respect to sign order.

The children on the whole produced few phrases with explicit actors; consequently, only David's data are suitable for an order analysis of intransitive and transitive actors. Figure 2 presents all of David's two-sign phrases containing transitive and intransitive actors classified according to the position of the actor case.[3] The data again suggest an Ergative pattern: Intransitive actors tended to occur in first position as did patients, e.g., David tended to point first at the actor, you, and then sign GO in conveying "you go there," just as he tended to point first at the patient, grape, before signing EAT in "you eat grapes." In contrast, David tended to sign transitive actors in second position of his two-sign phrases, e.g., he was likely to first sign EAT and then point at the actor, you, in conveying "you eat grapes." The deaf child's communication system, then, also appears to be Ergative when sign order data are considered.

Comparison to the Hearing Child

What can be said of the case marking patterns of young hearing children in general? We know ultimately that hearing children acquire the case marking patterns of their language models; that is, they eventually become polished speakers of the adult tongue that surrounds them. But what of developmental stages along the way? If Slobin's operating principle (Pay attention to the order of morphemes, 1973) were active, from the earliest stages the hearing child's ordering rules for patients and actors should follow adult models. Thus the hearing child learning English, an Accusative language, ought to "group" intransitive actors with transitive actors, at least with respect to ordering rules. The data on children learning English suggest that this is so: both intransitive and transitive actors tend to precede the verb, in contrast to the position of the patient case which tends to follow the verb (cf., Braine, 1976; Bloom, 1970).

Although it is likely that the young child's ordering patterns should be dictated by his linguistic model, it is far less reasonable to suppose that case production probability patterns are modeled in the same way. Case production probability, after all, is a phenomenon which is inherently dependent upon the young child's apparent length limitation; that is, at some stage, children appear to be forced to "choose" between explicitly saying the patient vs. the actor, precisely because the child at this stage is limited to a two- or three-word sentence length. Adults, of course, have no such length constraints on their utterances and therefore evidence no similar production probability

patterns. From these considerations, the young child might be predicted to be less influenced by his adult linguistic model in case production probability patterns than in case ordering patterns. The data, in fact, confirm this hypothesis. Young English-learners, like our deaf children and unlike adult English speakers, tend to group intransitive actors with patients with respect to production probability. Figure 3 presents a reanalysis of the data presented in Bloom, Miller & Hood (1974) for young speakers acquiring English at the two-word stage. We see that the patient (or Object in Bloom, et al.'s Agent-Action-Object phrases) was as likely to be explicitly mentioned as the intransitive actor (or Mover in their Mover-LocativeAction-Place phrases). Furthermore, the transitive actor (or Agent in their Agent-Action-Object phrases) was much less likely to be explicitly spoken than either of the patient or the intransitive actor cases.

The grouping pattern seen in Figure 3 is exactly that which we find in the deaf child's sign phrases; that is, intransitive actors resemble transitive patients in terms of production probability, and differ from transitive actors. Thus, we may tentatively conclude that where the linguistic model does not constrain the child, that is, in case production probabilities, the hearing child learning English has Ergative tendencies as do our deaf subjects. However, where the linguistic model does provide a clear pattern, that is, in ordering rules, the English-learning child exhibits the Accusative tendencies of his model.

In sum, we find that the deaf child's communication system exhibits the case marking pattern found in natural Ergative

languages, and, in at least this respect, can itself be said to be a natural language. Moreover, the fact that this system was developed under unqiue language learning conditions suggests that a young child, even in the absence of a conventional language model, can construct a communication system which bears striking resemblance to the early developmental stages of natural languages.

NOTES

1. I thank Rochel Gelman, Henry Gleitman, Elissa Newport, William Meadow and, particularly, Heidi Feldman and Lila Gleitman for their clarifying thoughts on nascent sign languages. Thanks also go to Lisette Tefo, Barbara Gray and Lorraine Stepneski for their help in transcribing videotapes, and to the children in the study and their families for their continued cooperation and friendship. This research was supported by grants from the Spencer Foundation through the University of Pennsylvania, and through the University of Chicago, and by funds from the Social Sciences Division of the University of Chicago. I was supported by the NICHHD Training Grant (HD 00337) and by an AAUW Fellowship during a portion of this work.

2. Evidence that all three "parts" of this message are, in fact, underlying the surface form is found in Goldin-Meadow, 1977.

3. Phrases containing points at pictures have been eliminated from this analysis primarily because these particular pointing signs tend to occur in first position of two-sign phrases regardless of the semantic case represented by that pointing sign.

TABLE I

Subjects' Ages at Each Session in Years and Months

	Sessions										
Subject	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Dennis	2,2	2,3	2,4	2,6							
Kathy	1,5	1,6	1,9	1,10	2,0	2,2	2,3	2,5	2,8		
Chris	3,2	3,3	3,6								
Donald	2,5	2,5½	2,6½	2,7	2,8	2,10	3,0	3,11	4,0	4,2	4,6½
David	2,10	2,11	3,0	3,3	3,5	3,6	3,8	3,10			
Tracy	4,1	4,3									

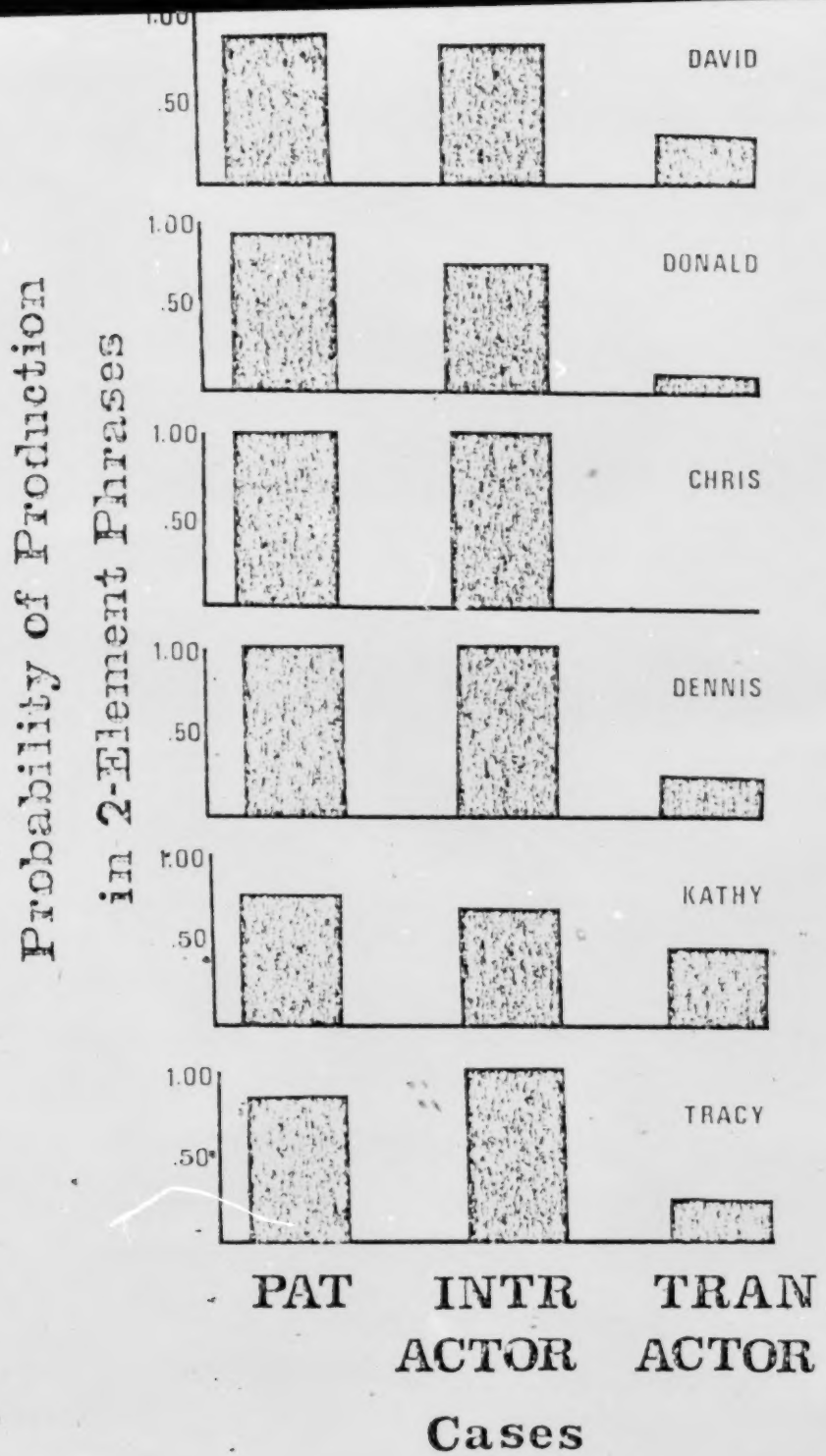

Fig. 1. Production Probability of Patient, Intransitive Actor, and Transitive Actor Cases. The data base for this analysis includes all two-element phrases with three-part underlying structures (actor-act-patient for transitive phrases, and actor-act-recipient for intransitive phrases). Probabilities are figured in terms of the number of transitive and intransitive phrases of these types produced by each child over the course of the study: for David, 88 transitive phrases and 35 intransitive phrases; for Donald, 29 and 8; for Chris, 7 and 1; for Dennis, 10 and 1; for Kathy, 9 and 3; for Tracy, 13 and 2. Pat=Patient; Intr Actor=Intransitive Actor; Tran Actor=Transitive Actor.

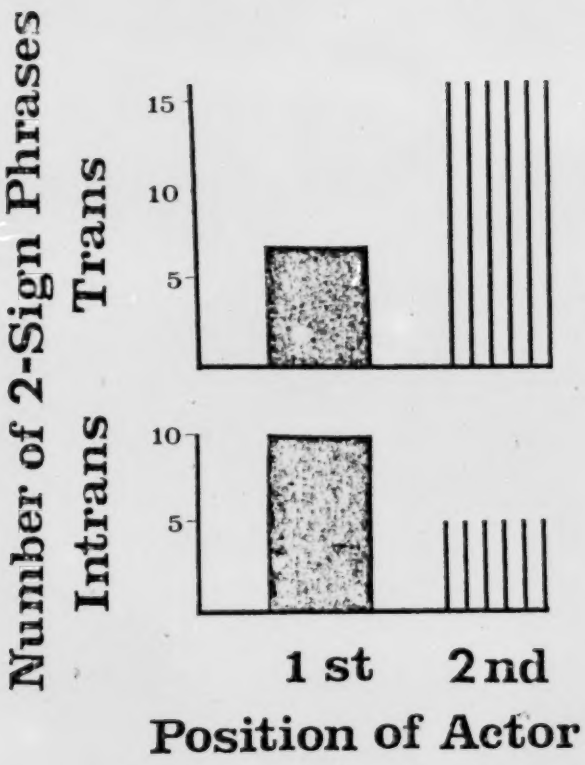

Fig. 2. Number of David's Two-Sign Phrases Classified According to the Position of the Transitive and Intransitive Actor. Transitive actors tend to occur in 2nd position while intransitive actors tend to occur in 1st ($\chi^2 = 4.82$, $p<.05$). Trans=Transitive; Intrans=Intransitive.

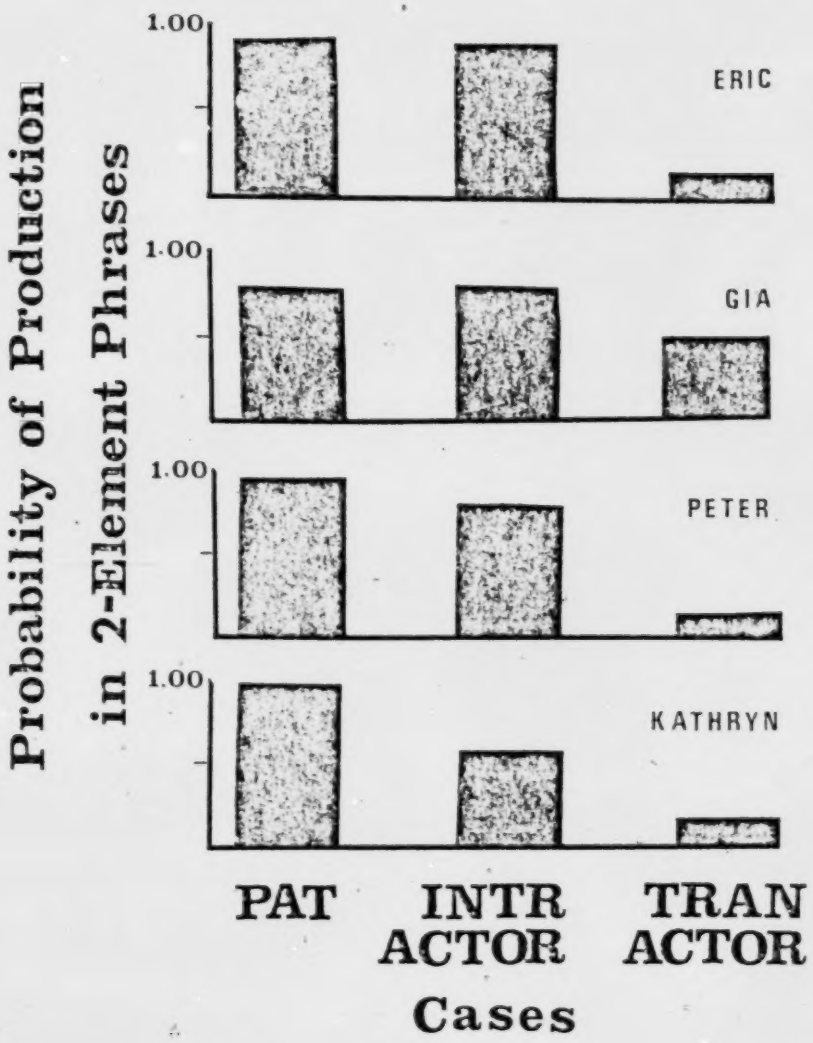

Fig. 3. Production Probability of Patient, Intransitive Actor, and Transitive Actor Cases for Four Hearing Children. The data base for this analysis is taken from Tables 4, 5, 6, and 7 in Bloom, et al. (1974) and includes all two-element phrases with three-part underlying structures (agent-action-object for transitive phrases and mover-locative action-place for intransitive phrases). Probabilities are figured in terms of the number of transitive and intransitive phrases of these types produced by each child over the course of the study: for Eric III-VI, 218 transitive phrases and 65 intransitive phrases; for Gia II-VI, 334 and 77; for Peter IV-IX, 311 and 34; for Kathryn I-IV, 447 and 111. Pat=Patient; Intr Actor=Intransitive Actor; Tran Actor=Transitive Actor.

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